

# Wastewater Systems

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Environmental Assistance Office

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# Agenda

Wastewater?

Community Responsibilities

- Viability

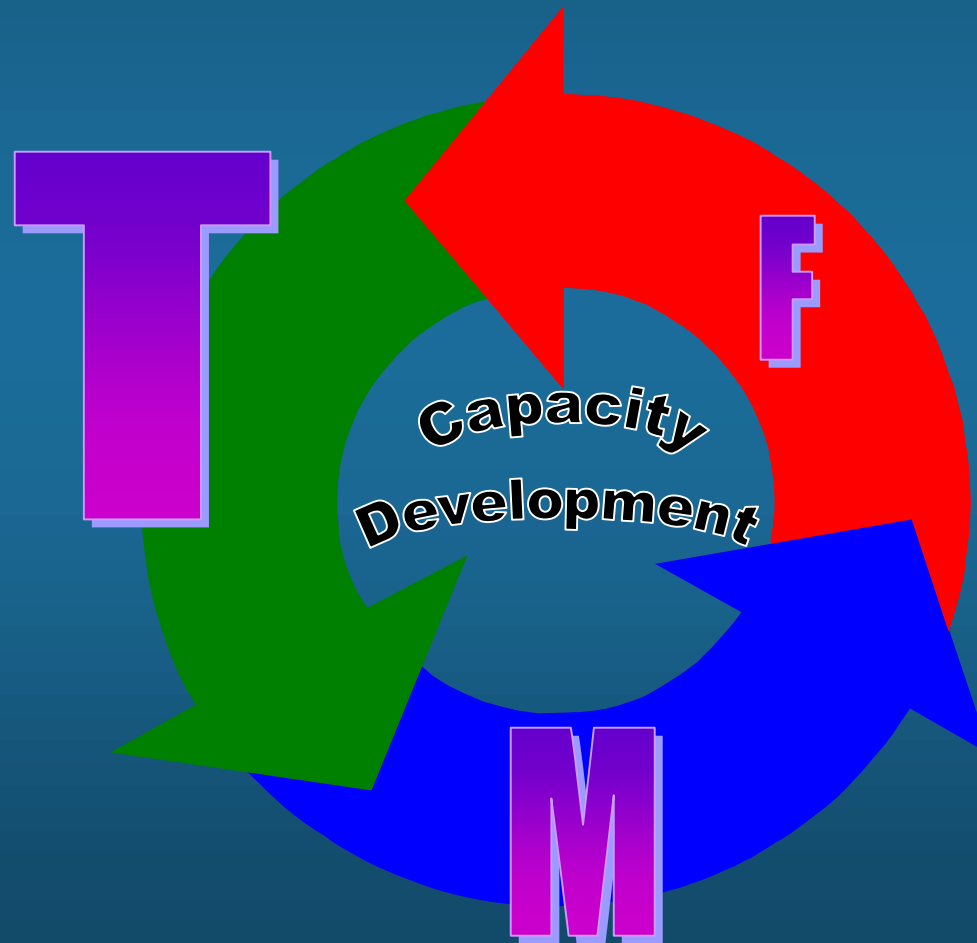
Wastewater Basics

- Process Overview
- Technologies

Problem Solving

Questions

# TMF Watch



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# What is Wastewater?

Water that has been used, as for washing or flushing or in a manufacturing process, and so contains waste products; sewage

# Why Treat Wastewater?

Prevent the spread of disease

Protect water resources

Insure adequate water supplies

# Waste Products / Pollutants

## Microorganisms

- bacteria
- viruses
- protozoan

## Toxics

- pesticides
- solvents
- heavy metals

## Nutrients

- phosphorus
- nitrogen
- ammonia

## Organic Matter

- plant sources
- animal sources

## Solids

# Domestic Wastewater Sources

Restrooms

Homes

Showers

Schools

Washing machines

Offices

Dishwashers

Restaurants

Kitchen facilities

Stores

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# Industrial Wastewater Sources

## Manufacturing Facilities:

- metals
- toxics
- oils

## Food Processing Facilities:

- high flows
- high strength

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# Storm Water Wastewater Sources

## Combined Sewers

### Inflow - above ground sources

- manholes
- downspouts
- sump pumps

### Infiltration - below ground sources

- damaged manholes
- faulty pump stations
- broken collection lines

# Wastewater Is A Local Responsibility

It is generated by the community

The community is the first defense in protecting public health

Meeting this responsibility involves the commitment of the community

.....and **IT'S THE LAW**

# Viabie Wastewater Systems

Maintain capability in the areas of:

- Technology
- Management
- Finances

Consistently comply with federal, state and local regulations.

# Technical Capacity

Hydraulic loading capability

Organic loading capability

Solids handling capability

Adequate staffing

Trained personnel

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# Certified Wastewater Operators

## Treatment facilities

- Serving 200 or more people or
- Having 50 or more service connections

## Owned or operated by:

- Municipal entities
- Private sewer companies
- State or federal agencies

# Certified Wastewater Operators

Certification levels: A through D

Exam and experience requirements

3 year certification

30 hours training for certificate renewal

# Technical Capacity

## Operations and maintenance

- O & M manual on site
- Lab equipment for process control and regulatory testing
- Scheduled maintenance
- Spare parts and emergency equipment
- Accurate operations record keeping
- Safety program

# Managerial Capacity Regulatory Compliance

Obtain required permits:

- Land disturbance permits
- Construction permits
- Operating permits

Operate within permit limits

Perform required testing

Submit monitoring reports



# Managerial Capacity Compliance Tools

Managerial policies and procedures

Ordinances:

- Pretreatment
- Sewer use
- User charge
- Fats, Oils and Grease (FOG)

System evaluation - MWPP

# Financial Capacity

Self-supporting utility

Budgets

Planning

Reserves

Emergency plan

Costs review

User rates review

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# If TMF Capacity is Lacking?

Problems such as:

- Unskilled, underpaid operators
- Understaffed systems
- Inadequate maintenance
- Overloaded infrastructure
- Inadequate financial resources

Can lead to ...

# Wastewater Technology you Choose Depends on...

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# How you Dispose of the Effluent

Surface disposal

Recycling / reuse

Percolation - On-site systems

Evapotranspiration - Arid regions

# Reuse and Recycling

## Irrigation:

- Some crops
- Silviculture (Managed Forests)
- Golf Courses
- Landscaping

## Graywater Recycling:

- Use for flush toilets

# Surface Disposal of Wastewater

- National Pollution Discharge Elimination System (NPDES) required
- Limits based on the characteristics and uses of the receiving water
- Requires regular monitoring / reporting

# Receiving Water Classification

- Mississippi River or Missouri River
- Lake or reservoir
- Losing stream
- A metropolitan no-discharge stream
- Special streams
- Subsurface waters / aquifers
- All other waters

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# Water Body Beneficial Use

- Livestock & wildlife watering
- Warm water aquatic life / fish consumption
- Cold water fishery
- Whole body contact
- Boating and canoeing
- Drinking water supply
- Industrial

# Effluent Limits Monitoring Requirements

Biochemical Oxygen Demand (BOD) - rate of oxygen use by organisms

Total Suspended Solids (TSS) - suspended solid particles

pH - basic or acidic condition of water

Fecal coliform - indicator bacteria - possible pathogens present

# Discharge Limits

	Miss. & MO	New Lagoon	New TF	Special Streams
BOD	30/45	45/65	40/60	10/15
TSS	30/45	70/100	40/60	15/20
pH	6-9	6-9	6-9	6-9
Fecal Coliform	400/ 1000	400/ 1000	400/ 1000	400/ 1000

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# Wastewater Disinfection

Required for “whole body contact”  
water body use

- Chlorination / dechlorination
- Ultraviolet (UV) light
- Ozone

# Wastewater Solids

All wastewater treatment systems produce “sludge” or settleable solids that remain following treatment.

Biosolids - Treated sludge, that meets Federal 503 Regulations - Class A or Class B

# Wastewater Solids

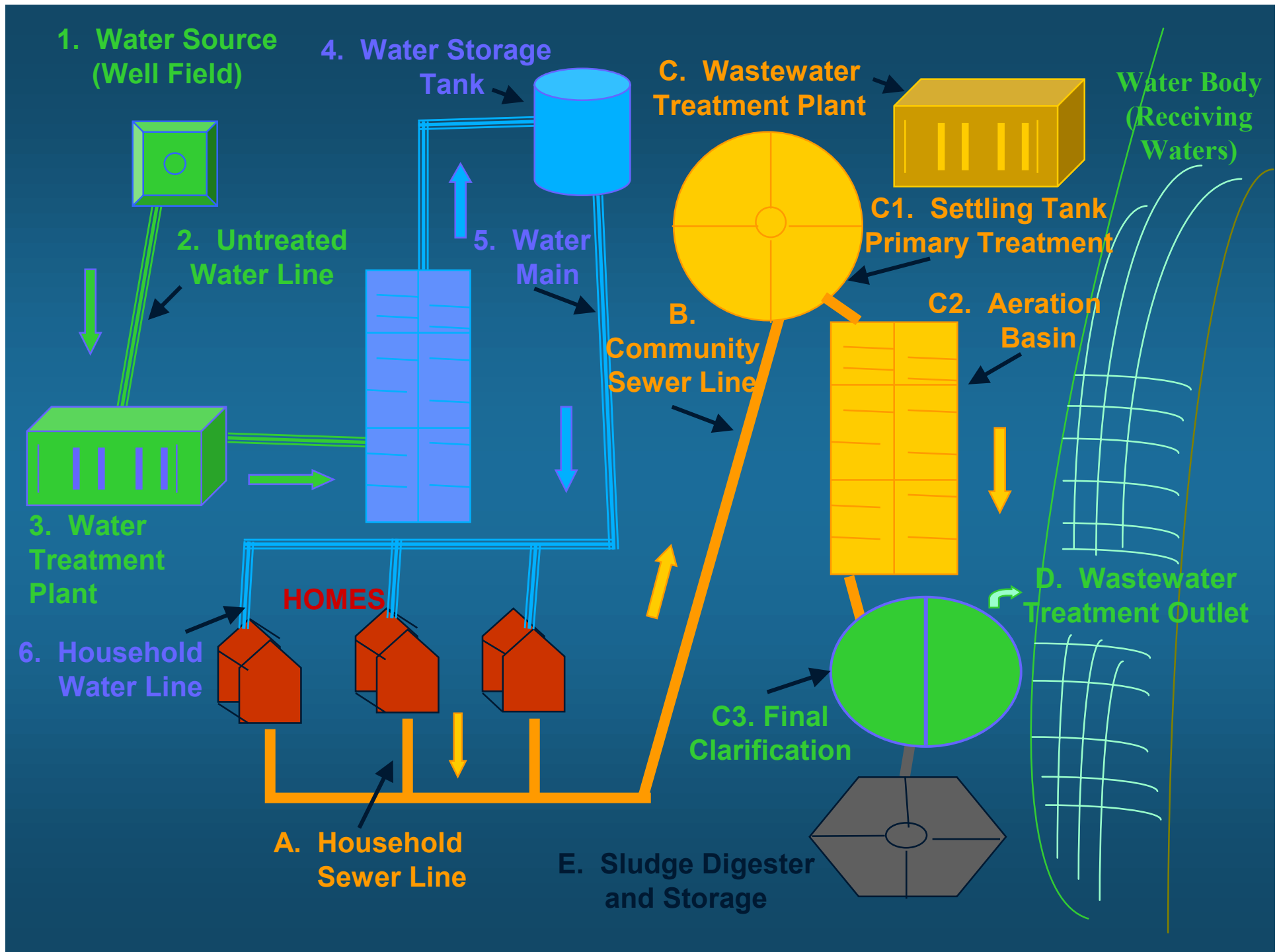
## Sludge treatment processes:

- aerobic digestion
- anaerobic digestion
- drying
- composting
- lime stabilization
- heat treatment

Requires adequate storage and disposal or reuse location

# Wastewater Cycle

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# Wastewater Process Overview

Three components of the wastewater process:

- Collection
- Treatment
- Disposal / reuse

# Collection Systems

Gravity sewers - combined sewers

Small diameter gravity sewers

Pressure sewers - STEP / grinder pump

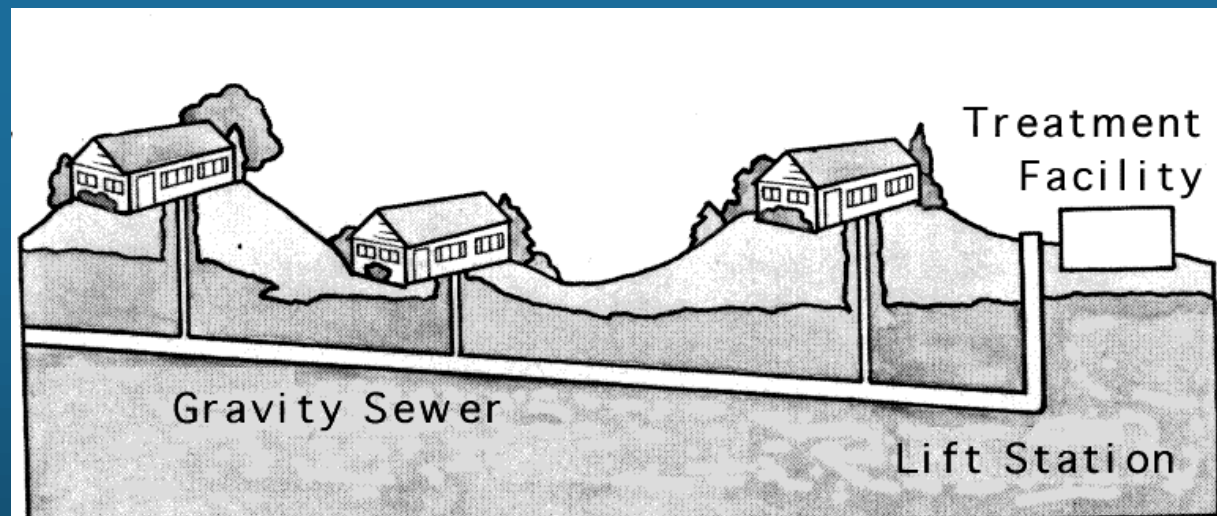
Vacuum sewers

# Conventional Gravity Sewers

Appropriate in densely populated areas

Gravity flow through sewers, and manholes to pumping stations and treatment

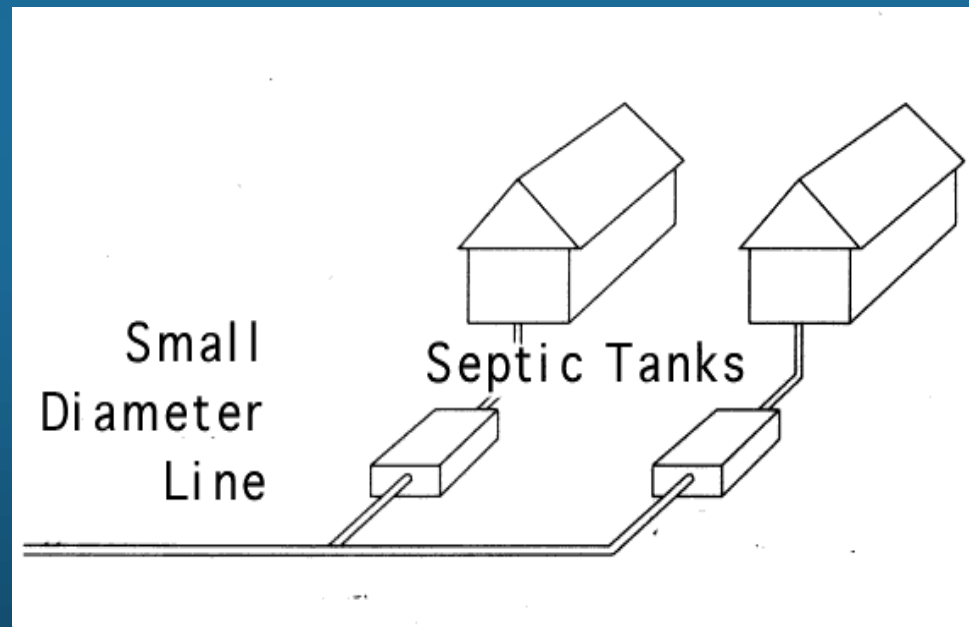
Potential infiltration and inflow problems



# Small Diameter Gravity Sewers

Solids - to septic tank

Effluent - to small diameter gravity lines to treatment unit or gravity collection system

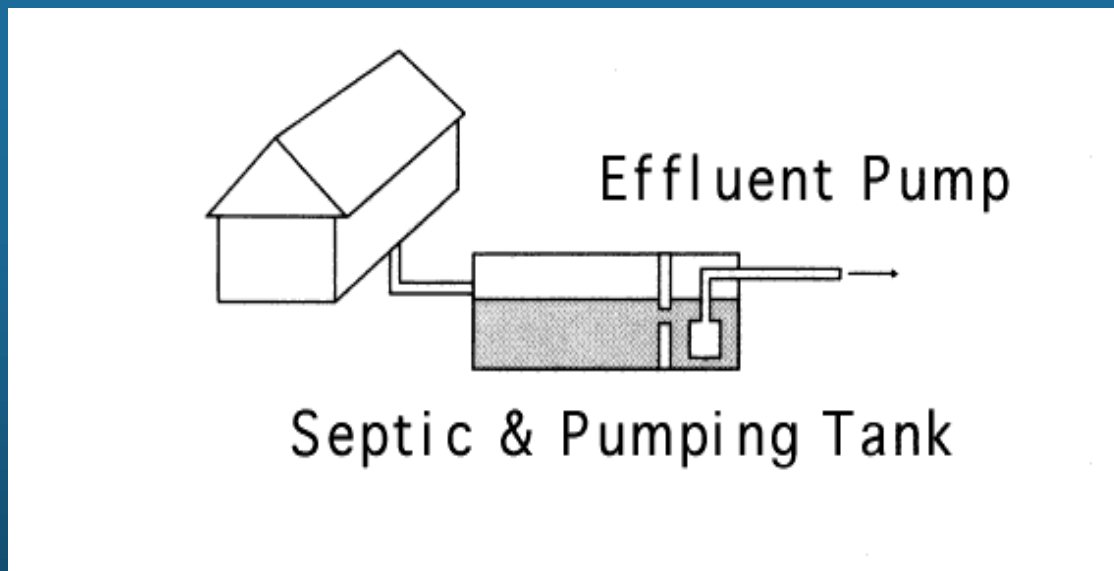


# Pressure Sewers: STEP

Septic tank effluent pumps (STEP)

Wastewater to septic tank - Solids settle

Effluent pumped to treatment plant

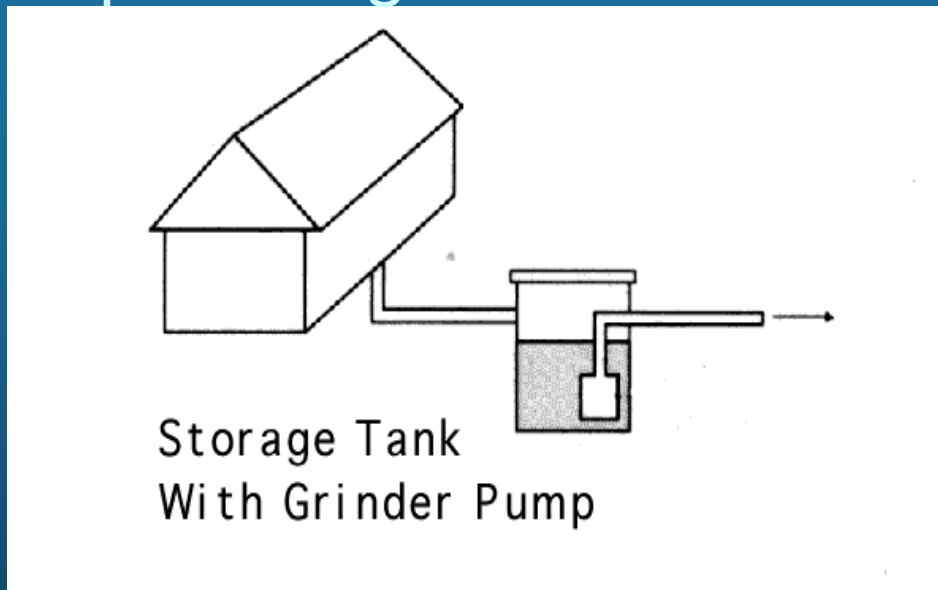


# Grinder Pumps

Storage tank - grinder pump

Effluent and ground solids pumped to treatment plant or gravity sewers

Requires regular maintenance

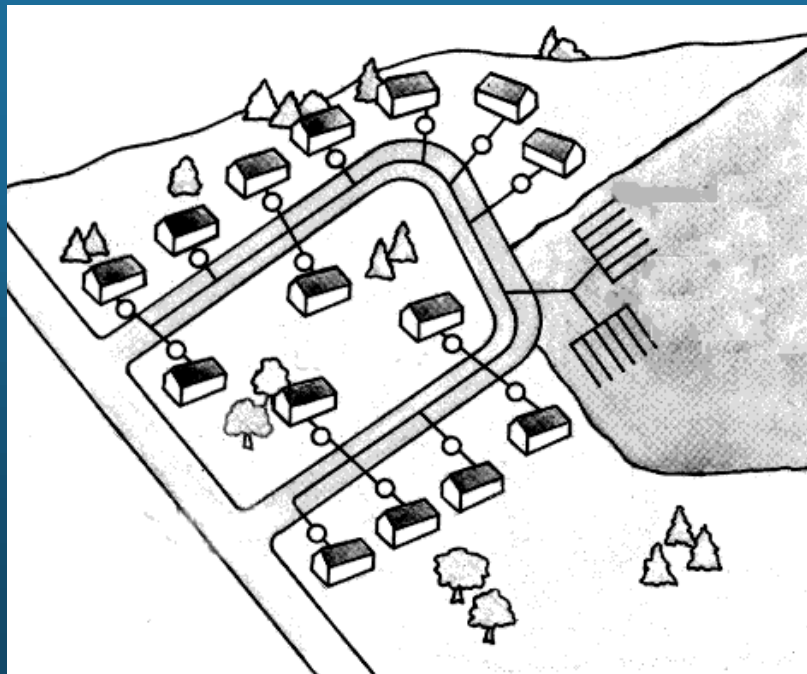


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# Cluster Systems

Alternative sewers - neighborhood treatment facility

Subdivisions w/ small lot sizes, far from central treatment



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# Treatment Systems

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# Goals of Treatment

Separate solids from liquids

Reduce organic materials (BOD)

Reduce nutrients

Reduce pathogens

Reduce toxic discharges

# Methods of Treatment



Physical

Biological

Chemical

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# Preliminary Treatment

## Removal of coarse heavy solids

- rags
- sticks
- sand
- toys
- clothing

## Equipment used

- Bar Screens
- Comminutors
- Grit Chambers

## Flow Equalization

- Equalization basin

# PRIMARY TREATMENT

## CLARIFICATION

- Separation of solids
- Settlable
- Floatable

# Secondary Treatment

## BIOLOGICAL REDUCTION OF BOD

- Fixed Film - trickling filters, rbc's, sand filter systems
- Activated Sludge
- Lagoon Systems
- Secondary Clarification

# Tertiary Treatment

Required to meet very stringent discharge limits

Filters

Removal of Nitrogen

Removal of Phosphorus

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# Types of Treatment

Soil-Based Systems

Land-Based (Natural) Systems

Mechanical Systems

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# Soil-Based Systems

On-site wastewater systems

Soil used for treatment and  
disposal/reuse

Department of Health regulations govern  
on-site systems in Missouri

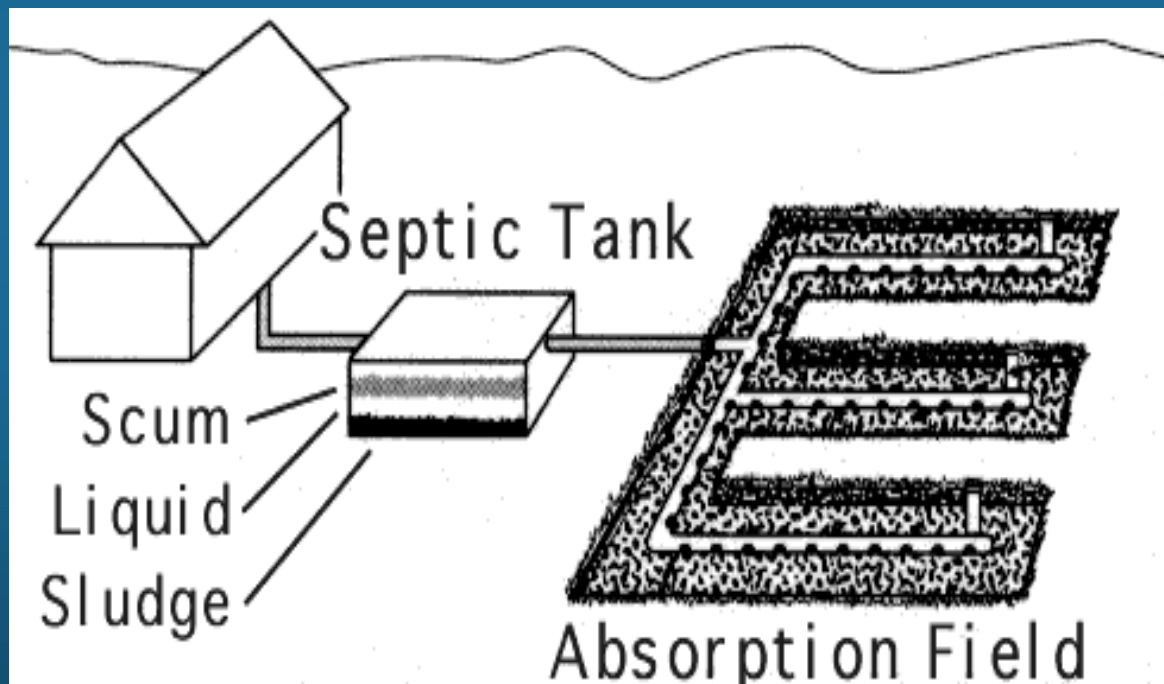
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# Conventional Septic System

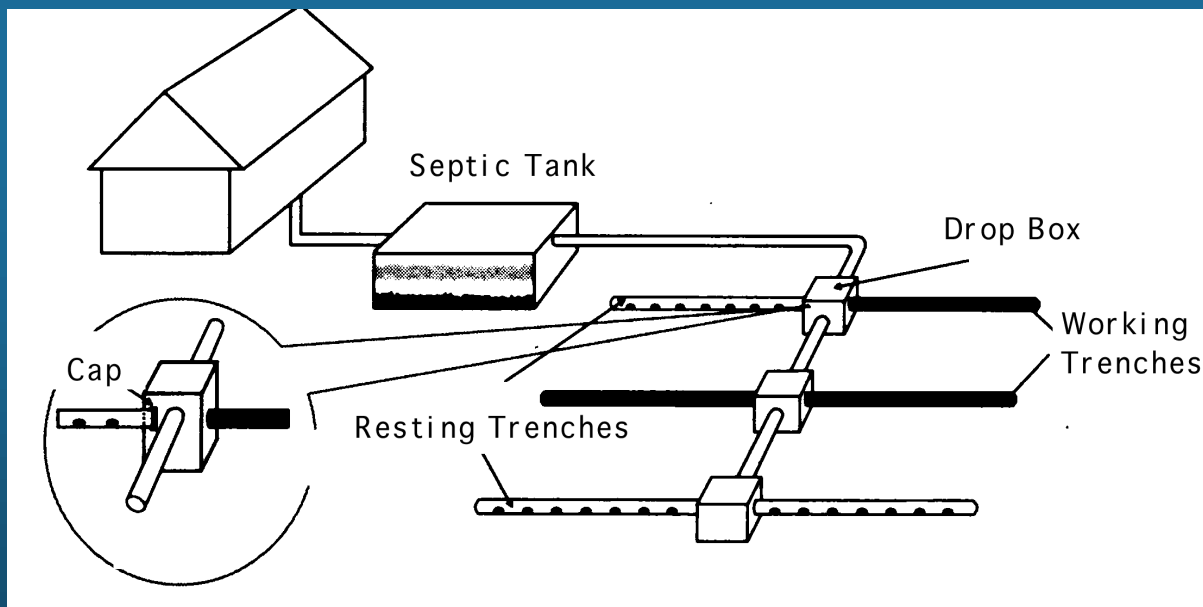
Septic tank - drain field

Adequate lot size, well-drained soils and limited slopes



# Drop Box Drainage Field

Drop boxes allow trenches to fill evenly  
Trenches can be capped to allow resting  
Allows placement on gentle to steeply  
sloped sites

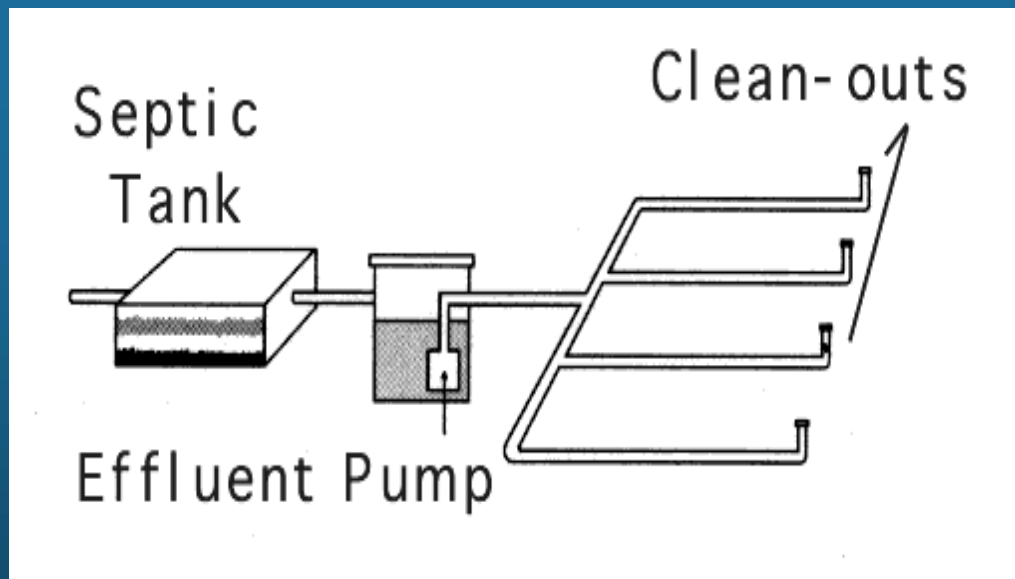


# Shallow Low Pressure Pipe System (LPP)

Septic tank - pump tank - shallow small diameter pressure distribution pipe

High groundwater, steep slopes, or shallow soils

Requires annual flushing



# Effective / Reliable On-site Systems are Properly:

Sited

Designed

Constructed

Operated

Maintained

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# Reasons For Septic System Failure

Inadequate maintenance

Under-design

Faulty installation

Damaged system

Poor soil conditions

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# On-site/Decentralized Wastewater Management

Management programs - the future of on-site wastewater for:

- Communities
- Cities
- Counties
- Sewer districts

# Five EPA Model Management Programs

1. System Inventory/Awareness of maintenance needs
2. Management - maintenance contracts
3. Management - operating permits
4. Utility operation and maintenance
5. Utility ownership and management

# Land-based (Natural) Systems



Lagoons

Constructed Wetlands

Land Application Systems

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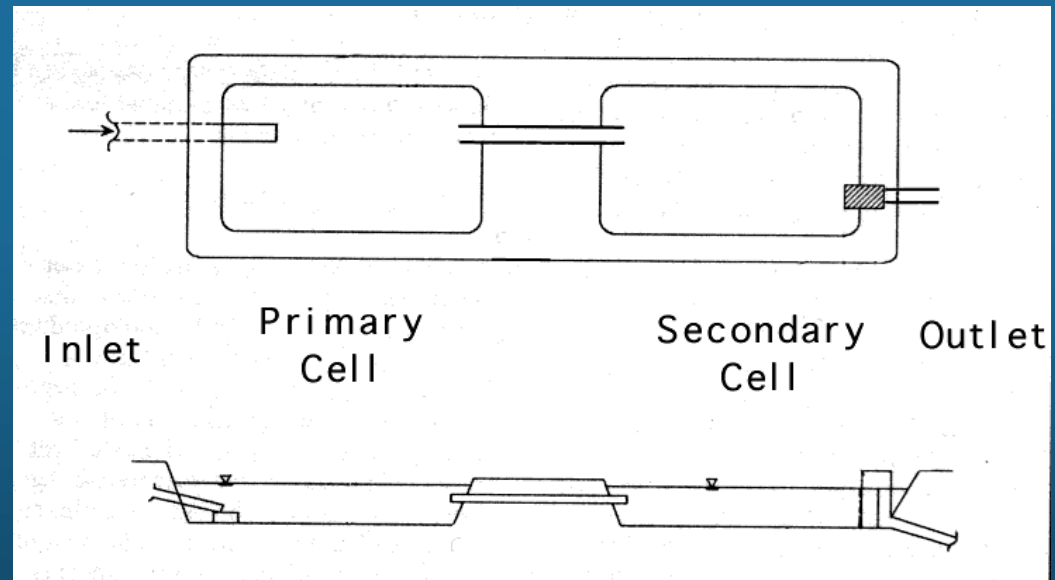
# Lagoons

Require considerable land

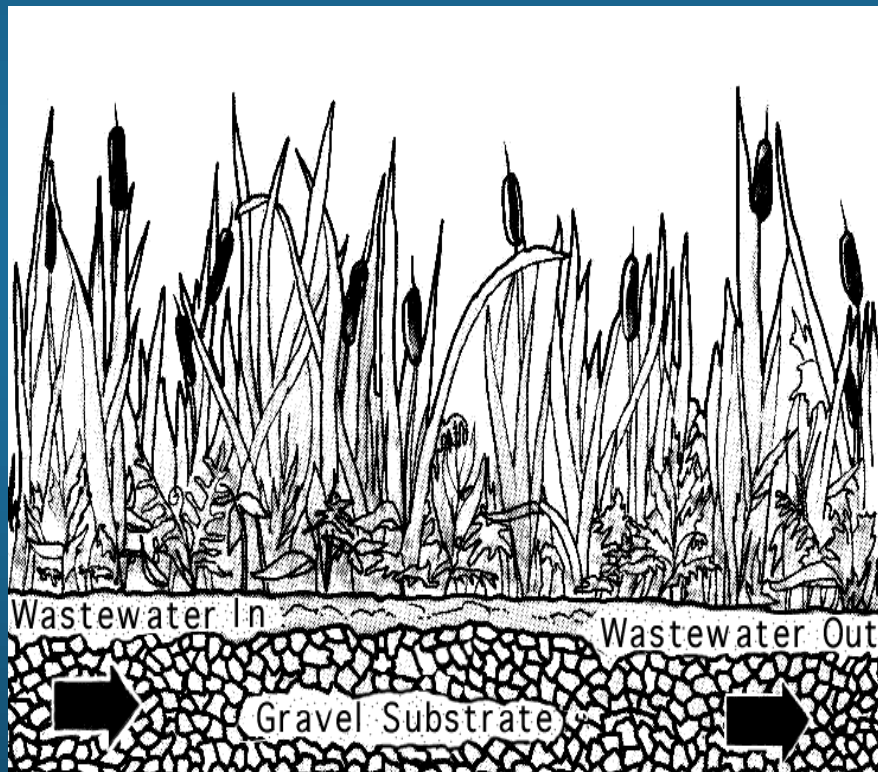
Simple to operate, handle shock loads

Types:

- **Aerobic**
- **Anaerobic**
- **Aerated**
- **Facultative**



# Constructed Wetlands



Year round  
treatment

Inexpensive  
operation

Land requirements

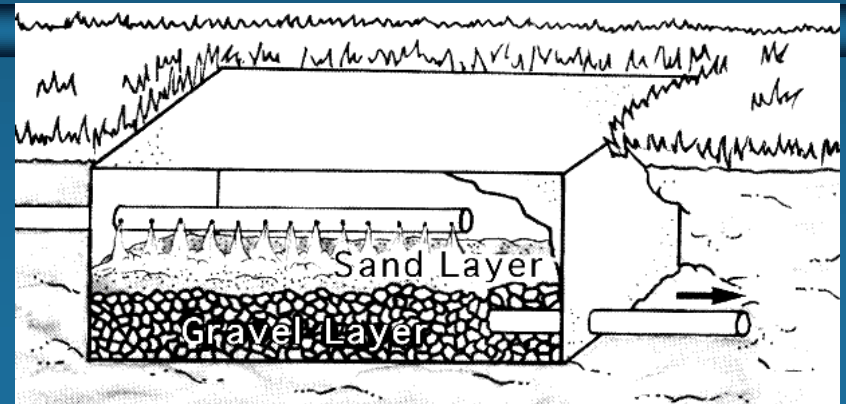
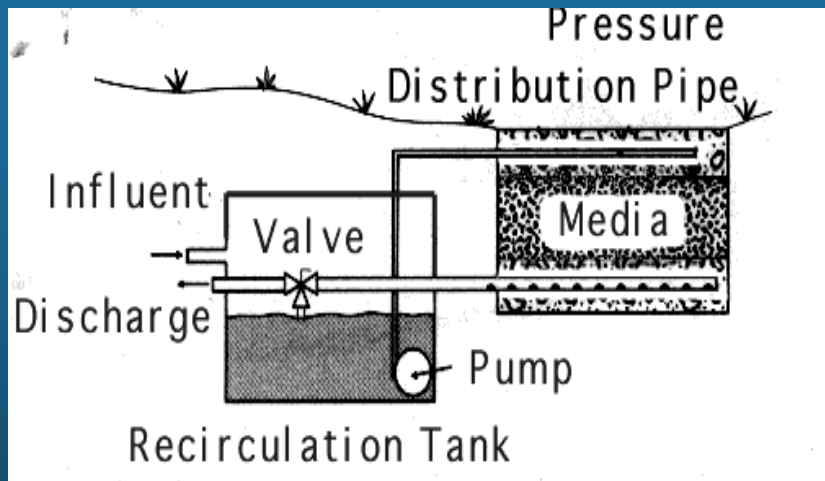
Must pre-treat  
wastewater

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# Sand Filters

Pretreatment required  
High quality effluent  
Low O&M costs

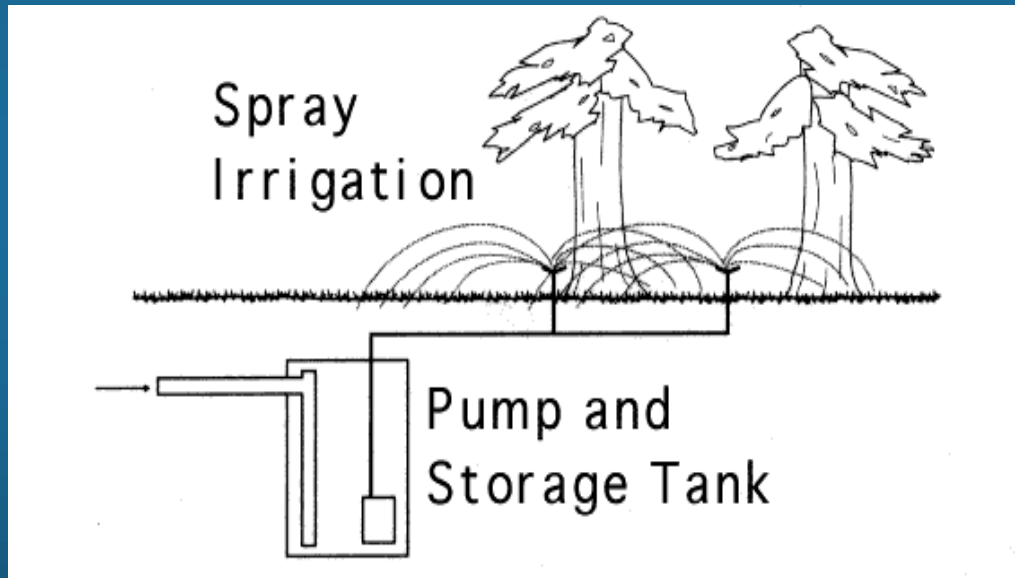
*Recirculating*



*Single Pass*

Surface discharge  
Subsurface discharge

# Slow-Rate Land Application



Treatment /  
disposal  
method

Pretreatment  
required

Beneficial reuse

Low tech

# Mechanical Treatment Systems

## Activated Sludge

- Conventional Activated Sludge
- Oxidation Ditch
- Sequencing Batch Reactor (SBR)

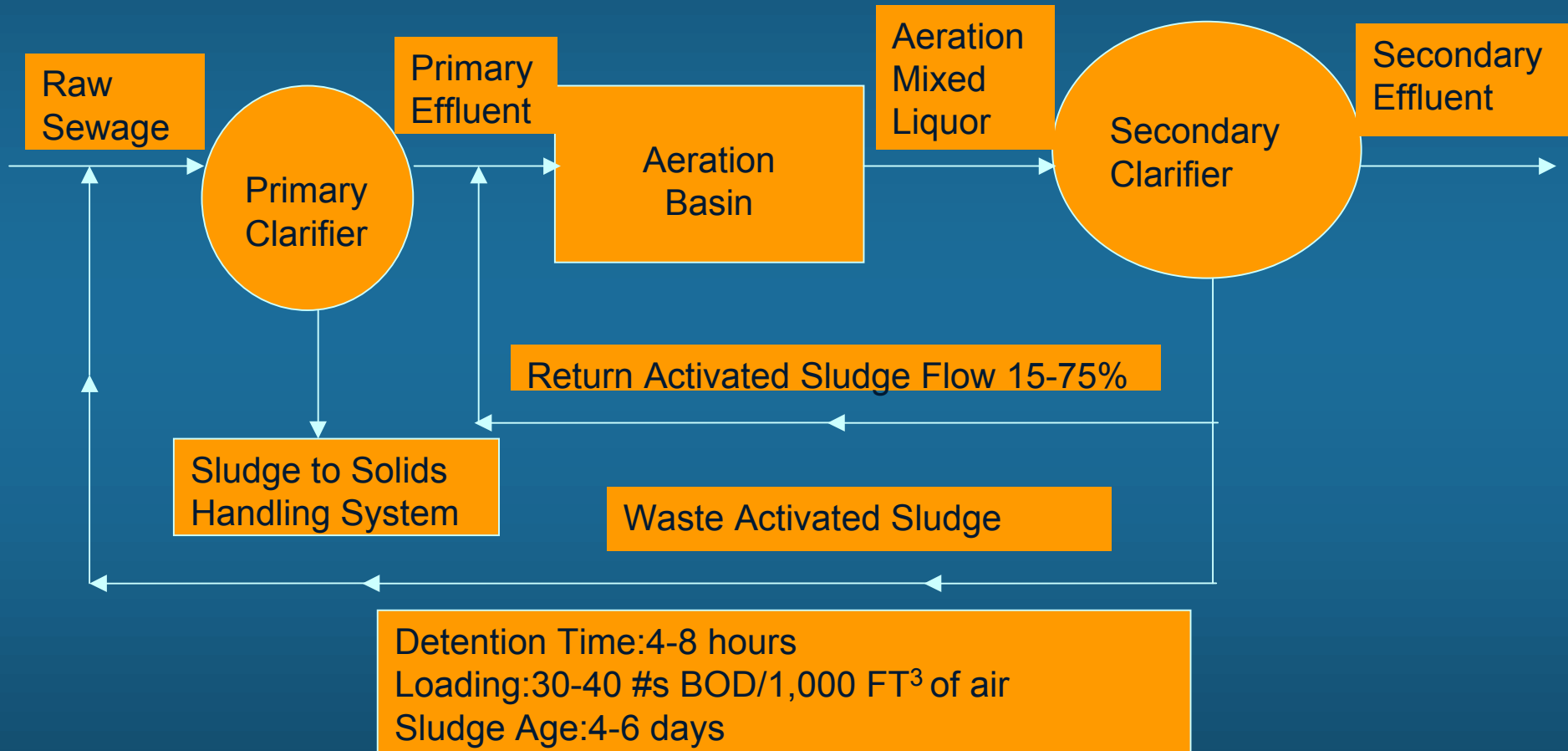
## Fixed Film

- Trickling Filter
- Rotating Biological Contactor (RBC)

# Activated Sludge Systems

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# Conventional Activated Sludge Process

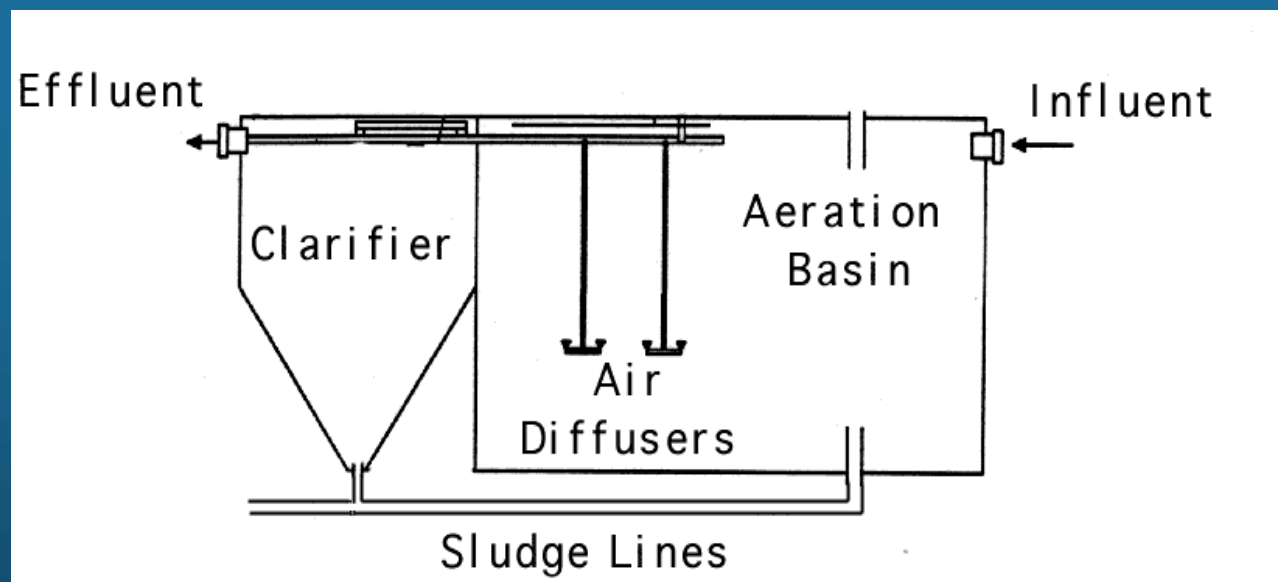


# Package Plant

Flows 10,000 - 50,000 gpd

Compact, pre-fabricated

Requires  
skilled  
certified  
operators



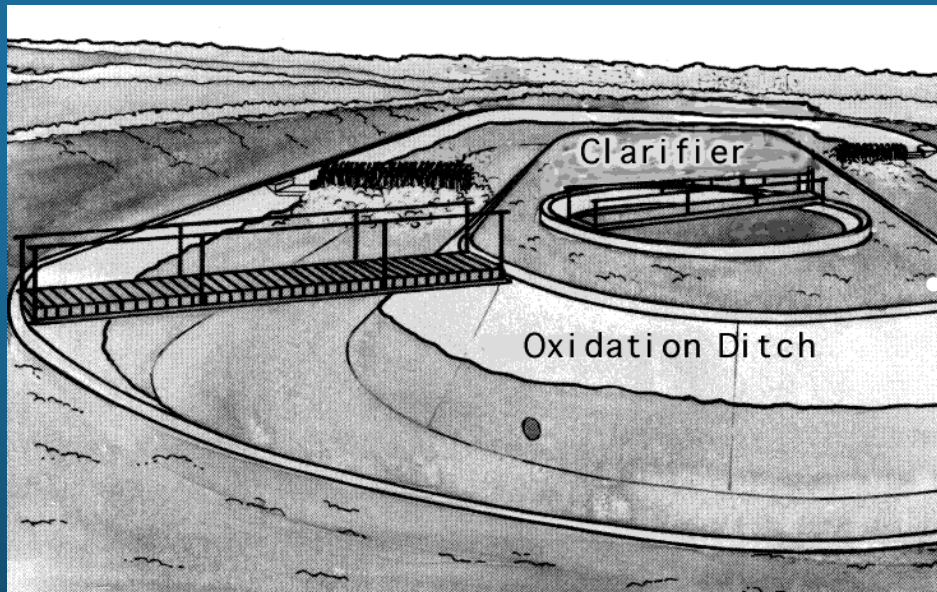


# Oxidation Ditch

Large footprint - Low O&M costs

Handles shock loads / hydraulic surges

Low sludge production



# How Does it All Fit Together?

It will be different for every community because every community is different

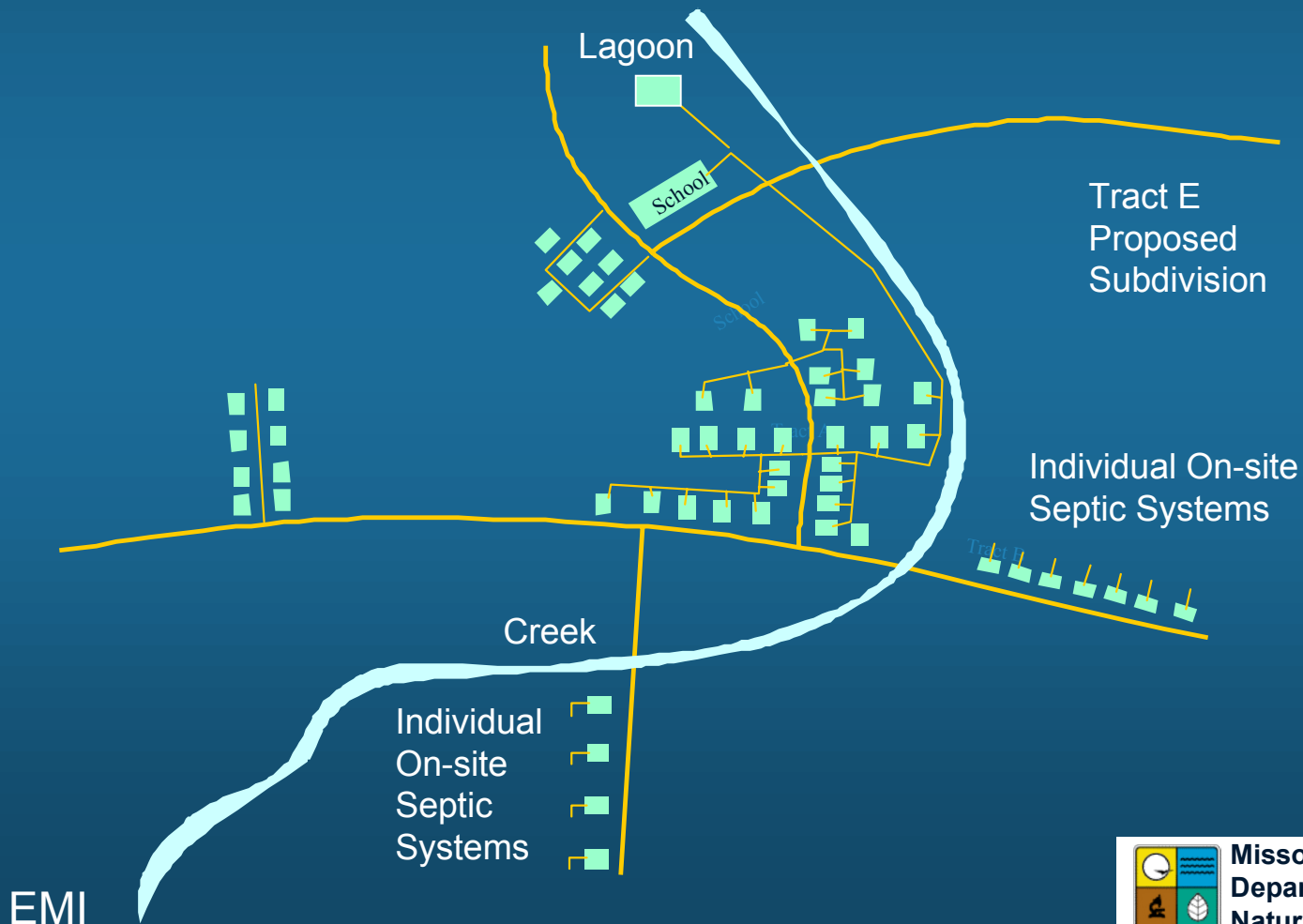
Variables include:

- topography
- land availability / cost
- population
- receiving stream
- finances
- commercial / industrial loading

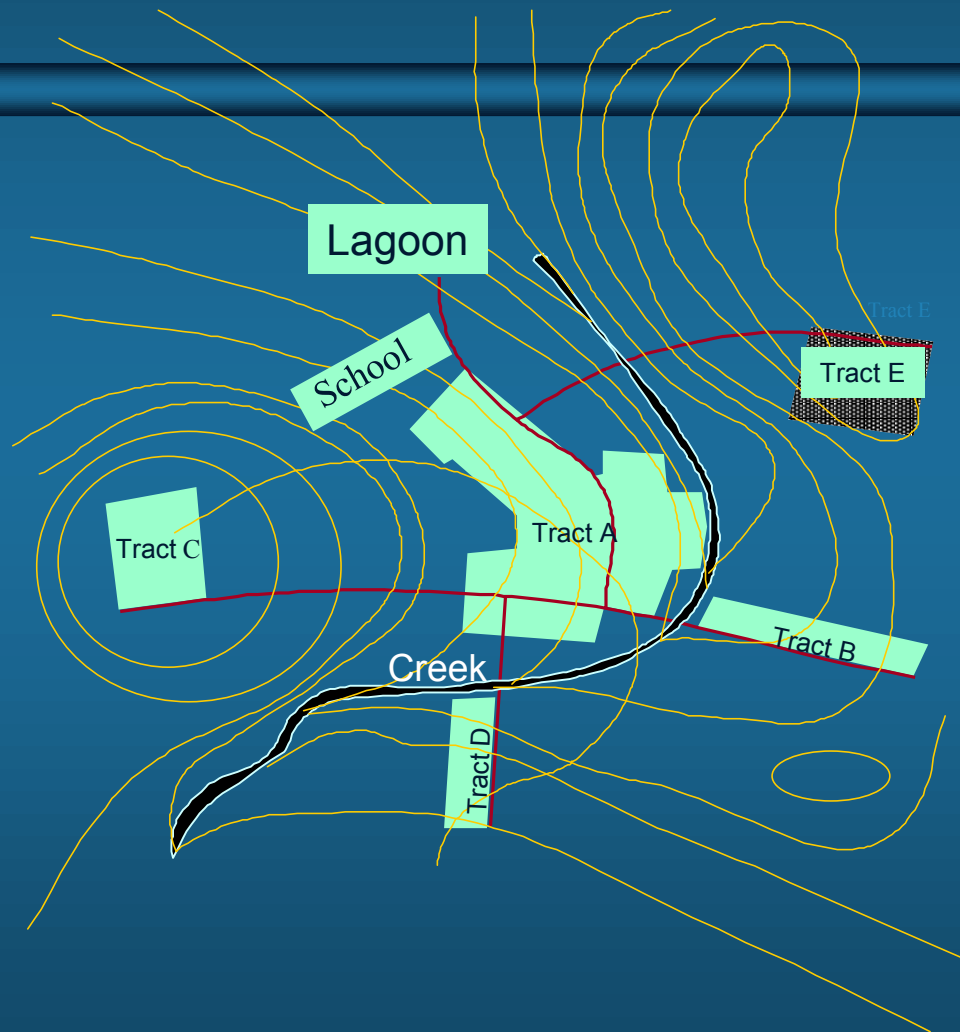
# Farm Town, USA

- Farming community - pop. 183 in 58 homes
- Single cell lagoon - serves 27 homes and business - out of compliance
- Failing on-site systems
- Residents income level low to moderate
- High water rate and water system problems

# Map of Farm Town: Connections



# Farm Town: Tracts



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# Recommended Solution



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# Cost Comparison of Options

Technology Option	Total Capital Cost	Annualized Capital Costs	Annual O&M Costs	Annualized Capital Costs plus O&M
Centralized System (Model A)	\$ 578,970	\$ 28,550	\$ 49,320	\$ 77,870
Centralized w/ cluster and onsite (Model B)	\$ 378,178	\$ 12,826	\$ 27,514	\$ 40,340
Centralized w/ onsite	\$ 422,451	\$ 19,780	\$ 28,110	\$ 47,890

# Addressing Needs & Solving Problems

- Define problem / Assess needs
- Enlist aid of consultants / assistance providers / operators
- Consider any viable alternative
- Evaluate initial and continuing costs
- Make informed choices



# The Result of Your Commitment

Help Lead Your Community to:

A Viable

Affordable

Effective

System

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# Questions?

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# Technical and Financial Assistance Sources

## Federal Agencies

- U.S. Department of Agriculture
  - Rural Business & Cooperative Development Service
  - Rural Development

# Technical and Financial Assistance Sources

## State Agencies

- Department of Economic Development
  - Community Development Block Grants Program
- Missouri Department of Natural Resources
  - Water Pollution Control Program
  - Regional Offices
  - Environmental Assistance Office

# Technical and Financial Assistance Sources

## Other Agencies

- Missouri Rural Water Association
- Midwest Assistance Program
- Regional Planning Commissions and Councils of Government

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# Postscript

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# Additional Collection Systems

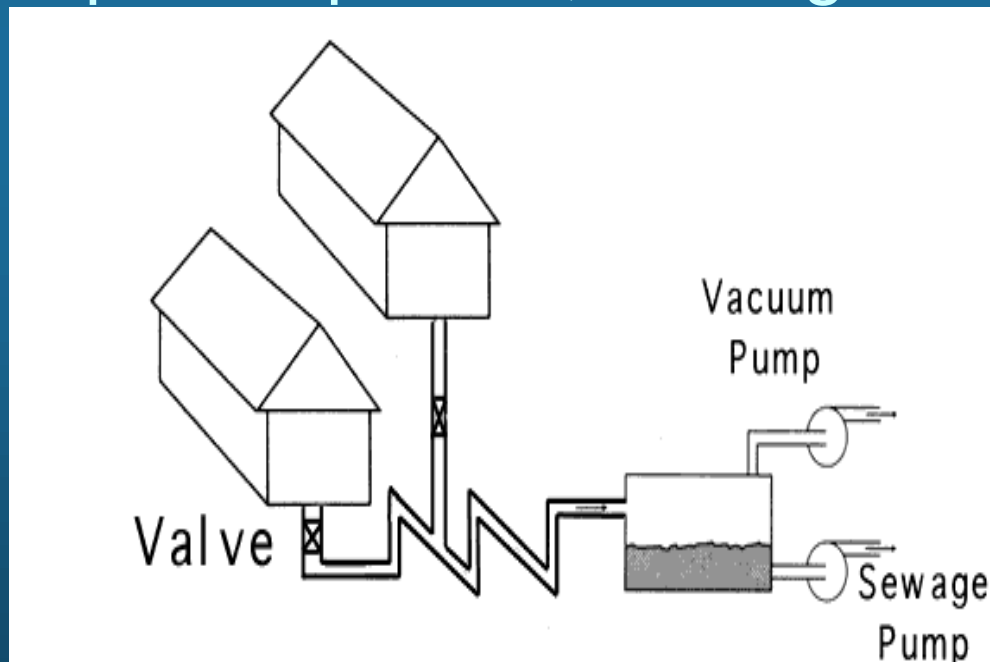
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# Vacuum Sewers

Suction moves sewage through vacuum lines to central collection tank

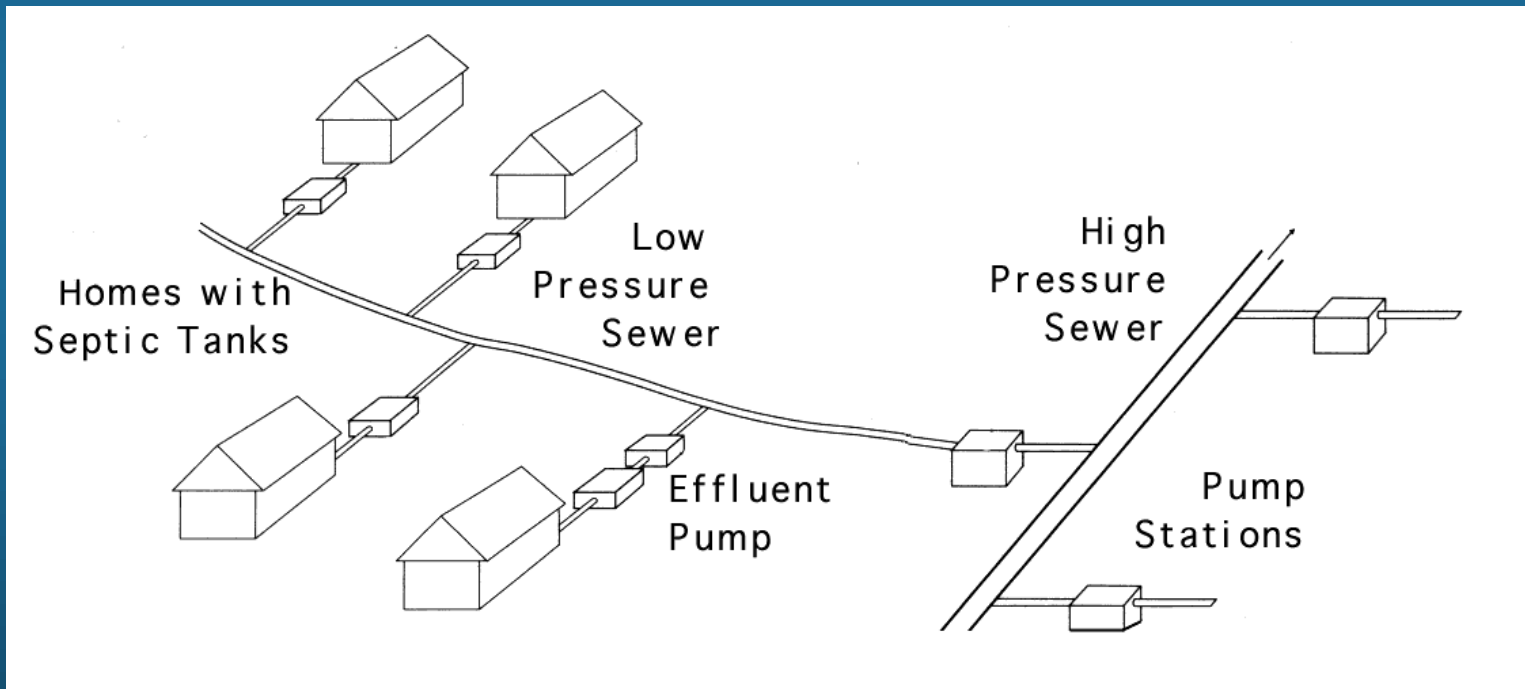
Requires operator; has high O&M



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# Alternative Effluent Collection

Small diameter, shallow lines



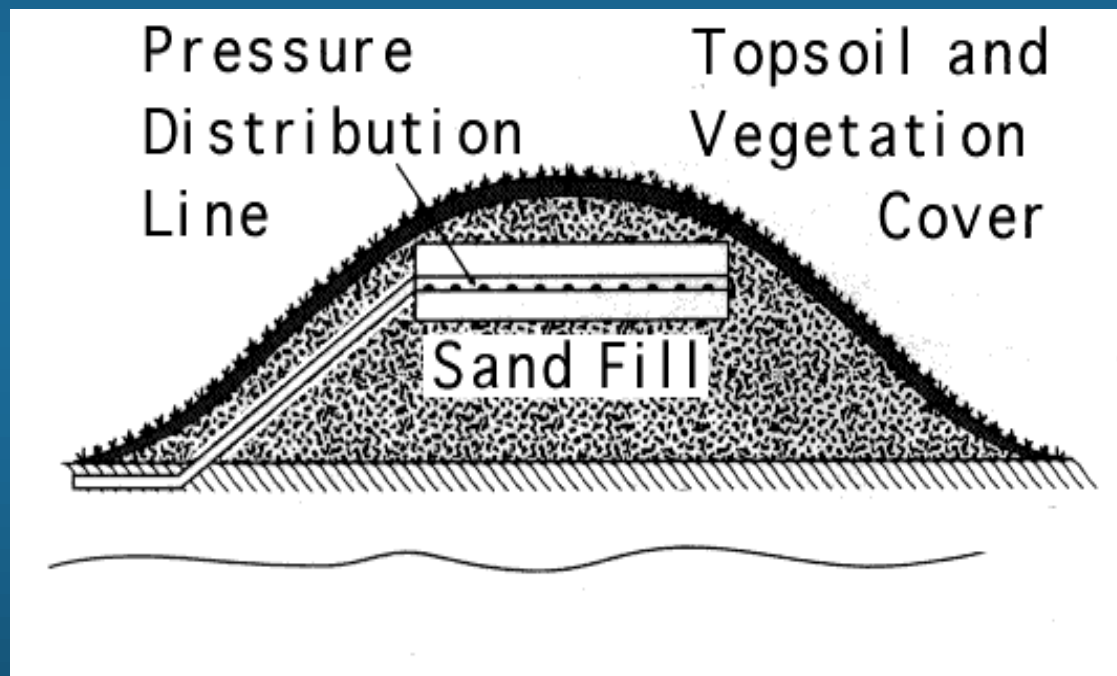
# Additional Treatment Systems

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# Mound System

Septic tank - pump tank - pressure distribution - sand mound

Poor soils, shallow bedrock, or high water table

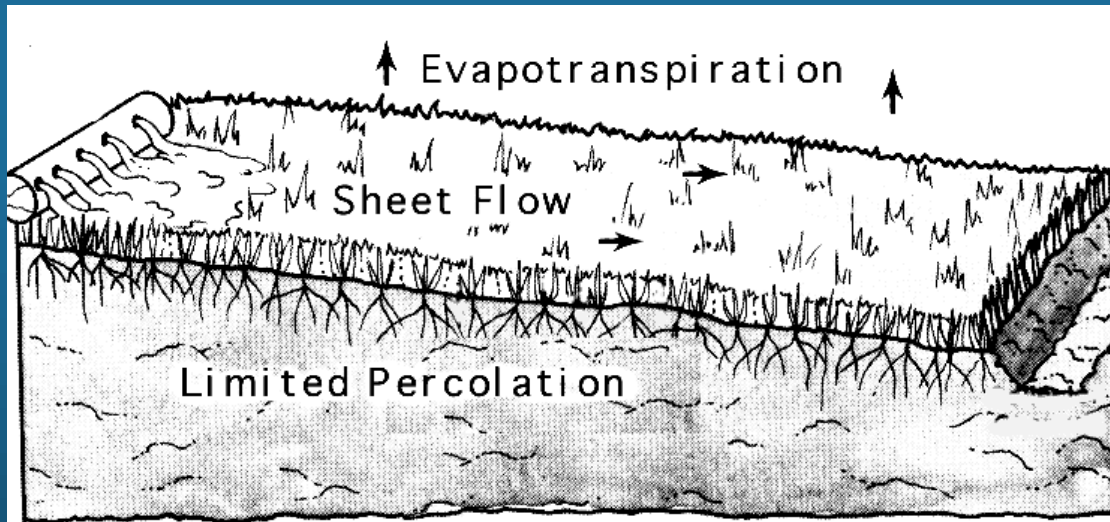


# Overland Flow

Land-based treatment process with a point-source discharge

Pretreatment required

Low tech



# Additional Activated Sludge Systems

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# Sequencing Batch Reactor (SBR)

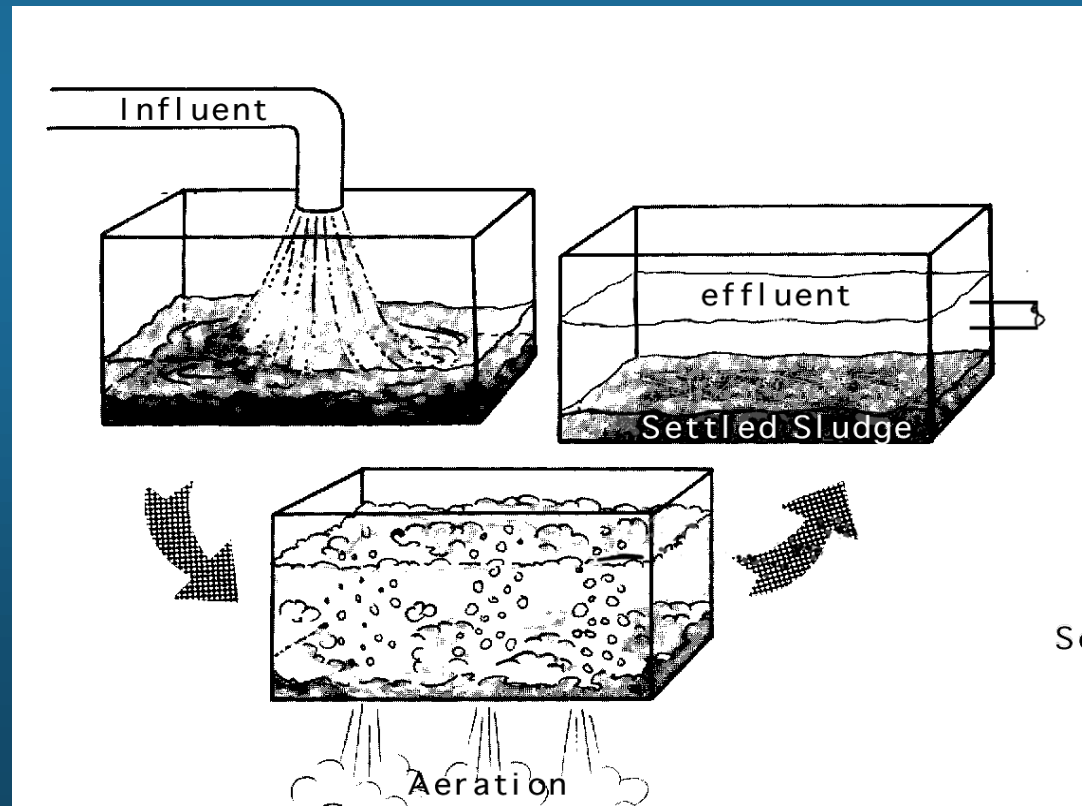
Equalization, primary clarification, treatment and secondary clarification in single reactor

Small footprint

High tech

High O&M costs

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# Fixed Media Treatment Systems

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# Trickling Filters

Requires primary treatment

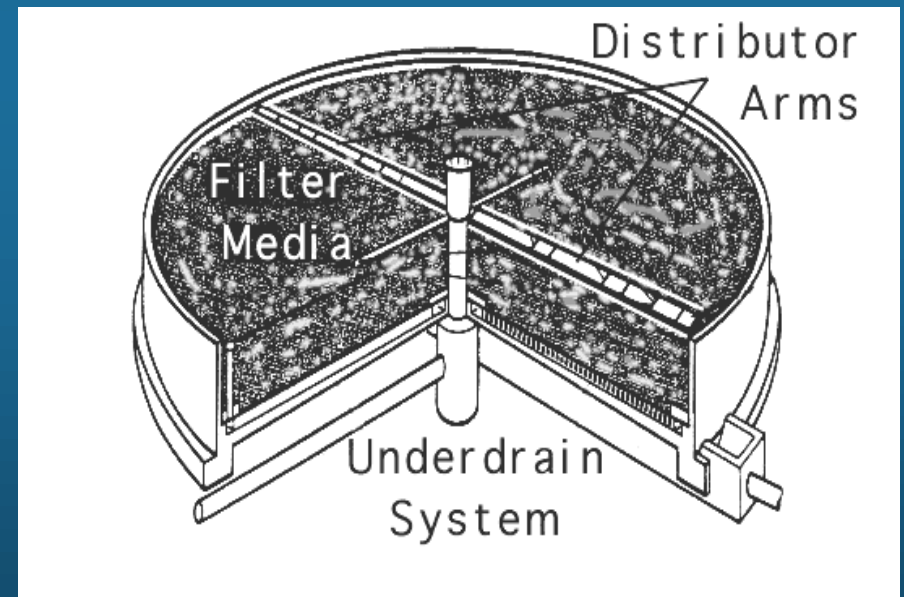
Small footprint - Moderate tech level

Low power requirements

Nitrification

Additional treatment needed for tight discharge standards

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# Rotating Biological Contactors (RBC)

Requires primary treatment

Small footprint - Moderate tech level

Nitrification

Additional  
treatment  
needed for  
tight  
discharge  
standards

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